



EXAMINING SPATIAL DYNAMICS OF INFANT MORTALITY ACROSS INDIAN STATES: CONVERGENCE OR DIVERGENCE?

Dr. Rejuna C A¹, Ms. Sona Muraleedharan², Ms. Murshida Sulthana³

¹ Associate Professor of Economics, Government College Kasaragod, Kasaragod, Kerala

² Research Assistant, Gulati Institute of Finance and Taxation, Trivandrum, Kerala.

³ Research Scholar (Junior Research Fellow), Government College Kasaragod, Kerala

ABSTRACT

The development trajectory of Indian states has been a subject of significant interest and debate. Over the years, the question of whether there has been convergence or divergence in development across the states has garnered attention. This paper examines the overtime convergence in development indicators across 16 major Indian states from 1990 to 2019, particularly health status indicator like infant mortality rate. The data utilized originates from secondary sources, namely EPWRF India and RBI database encompassing per capita income, infant mortality rate and state-wise population data. The study employed sigma convergence to assess the regional disparity of economic development across the states in India. The sigma convergence reveals a consistent pattern, signifying a trend of convergence of development across the states. To further explore this phenomenon, the study introduces the disparity in the coefficient of variation (CV) of infant mortality rates between regions with higher and lower economic statuses. This results in the emergence of an inverted U-shaped curve, indicating a distinctive pattern in the convergence of development. Hence, the study indicates convergence in terms of infant mortality rate among states in India over the years, with initially disadvantaged states making progress towards reducing IMR. These findings offer valuable insights for policymakers, aiding them in crafting strategies that foster more balanced economic development across diverse regional landscapes.

KEYWORDS: Development, Convergence, Sigma Convergence, Health Status, Infant Mortality Rate, India

INTRODUCTION

The concept of development convergence, wherein less developed regions tend to narrow the gap with more developed counterparts over time, has been a subject of interest in economic and social studies. This paper primarily explores the development trajectory of Indian states and examines convergence or divergence of development across Indian states. The performance of development indicator like health status among the states is examined through selected health indicators like IMR (Infant Mortality Rate). Infant mortality reflects the overall health and well-being of a population and serves as a valuable metric for gauging socio-economic progress. Therefore, a comprehensive perspective is needed to address infant mortality as an indicator of development across Indian states.

Infant mortality rate, representing the number of infant deaths per 1,000 live births, encapsulates a multifaceted interplay of socio-economic, healthcare, and environmental factors. A lower IMR is not only indicative of improved healthcare systems but also reflective of broader developmental advances, encompassing education, income distribution, and social infrastructure. As such, studying the trajectory of development through the lens of IMR provides valuable insights into the trajectory of overall societal progress. Understanding whether regions with historically high IMRs are narrowing the gap with those enjoying lower IMR hold profound implications for public health policies, welfare initiatives, and the broader

spectrum of socio-economic development.

The infant mortality rate is widely recognized as a significant development indicator that reflects the combined influence of economic development, technological advancements, health interventions, and the socio-cultural environment. Numerous studies have been conducted to assess the impact of various determinants on IMR. For instance, research on IMR and child mortality trends in Kerala revealed that socioeconomic factors accounted for only a minor portion of the disparities observed at the household level. The reasons for comparatively low infant mortality rates in the Indian state of Kerala are examined and the study stress on the importance of improvements in education and in the health care delivery system (Philip E, 1985).

The influence of other factors such as access to adequate sanitation facilities, hygienic cooking utensils, reliable fuel sources, and ownership of household goods has also been examined in a 1998 report by the National Family Health Survey (NFHS-2) in India. Moreover, a recent report by the World Bank further substantiated the previously established inverse relationship between per capita income and IMR in India. The increased public health expenditure is associated with a reduction in IMR (Barenberg, Basu, & Soyulu, 2017). Additionally the study highlights positive effects of political competition, female literacy, and urbanization in reducing the IMR among the major Indian states

Suriyakala et al., (2016) found that several factors influence

infant mortality rates in India such as fertility rate, national income, women in the labor force, expenditure on healthcare, and female literacy rates, alongside healthcare infrastructure variables. Their findings reveal that these factors have a significant impact on infant mortality rates. Moreover, healthcare infrastructure, including access to essential services, reproductive health facilities, and immunization programs, significantly impacts infant mortality. Political competition and efficient governance can also drive healthcare policy prioritization, leading to improved healthcare outcomes and lower IMR and faster economic development. Gosh (2016) states that states with lower per capita income have managed to bridge the gap in terms of human development, challenging the conventional notion that economic affluence necessarily leads to enhanced human development. Barman and Talukdar (2014) recognise infant mortality rate as a key indicator of socio-economic development, and examines the trend of infant mortality over recent years.

Differences in income per capita among Indian states show a strong correlation with health indicators like life expectancy, infant mortality, and rates of institutional delivery. There's a two-way relationship between income and health: healthier individuals tend to be more productive, learn better, and have incentives to invest in their education due to longer life spans. Similarly, higher income levels contribute to improved health through better nutrition and the development of public health facilities. These states demonstrate diverse trajectories of growth and development, forming distinct groups with varying statuses. Interestingly, the historical trends reveal that while health disparities have reduced at a faster rate than income disparities over time, both have followed similar paths. This highlights the need to empirically investigate the ongoing convergence in health status across Indian states. The concept of convergence in the context of infant mortality as an indicator of development refers to the narrowing of the gap in infant mortality rates between different regions, countries, or socioeconomic groups. Convergence suggests that over time, less developed or disadvantaged regions or groups are catching up with more developed or advantaged ones in terms of reducing infant mortality rates. The study aims to explore whether health status is catching up with the pace of economic development, examining the potential convergence over time.

2. OBJECTIVES

- To examine overtime convergence happening in development indicators across the Indian states. The convergence in development indicator like health status among the states is examined through selected health indicators like infant mortality rate.

The study examines infant mortality rates as an indicator of development across the Indian states to check convergence of development. It evaluates the performance of infant mortality rates of major Indian states and examine whether regional disparity in it has increased or decreased over time.

3. DATA SOURCE AND METHODOLOGY

The study used secondary data on infant mortality rate as the

development indicator. The state-wise data has been collected for the time period 1990-2019, on the base year 2011-12 series. The study tries to examine the indication of convergence of development across the states in India through the health status indicator like infant mortality rate.

Time series data from 1990 to 2019 on per capita net state domestic product (PCNSDP) and infant mortality rate were gathered from the Economic and Political Weekly Research Foundation India database, utilizing the 2011-12 back series. The analysis focused on a selection of 16 states such as Haryana, Maharashtra, Odisha, Andhra Pradesh, Assam, Bihar, Himachal Pradesh, Kerala, Karnataka, Tamil Nadu, Uttar Pradesh, Madhya Pradesh, Punjab, Rajasthan, West Bengal, and Gujarat were chosen for their population significance. The study employs alpha convergence to check the convergence of infant mortality rate among Indian states as an indicator of development.

4. RESULTS AND DISCUSSIONS

The study employs infant mortality rates as a developmental gauge across different states in India, aiming to assess the trend of development convergence. First, the states have been classified into two groups such as Group I and Group II on the basis of median PCI. Group I indicates the states whose per capita income falls above the median PCI and Group II indicates lower income states whose per capita lies below the median. Second, the study examines the per capita income of the states at two sub period. The first scenario of 1999-2000 is taken as a reference point from where the initial position of each can be compared. The comparison of initial year positions with the year 2019-20 gives us insights on how the position have changed within and across groups based on this classification and also evaluate the performance of infant mortality rates.

INITIAL YEAR (1990-91)				FINAL YEAR (2019-20)			
Higher income group							
STATES		PCI (Rs)	IMR	STATES		PCI (Rs)	IMR
1.	Punjab	56168	61	Haryana	197872		28
2.	Karnataka	51588	70	Gujarat	187524		23
3.	Maharashtra	50705	58	Tamil Nadu	180651		13
4.	Haryana	49388	69	Karnataka	173942		19
5.	Himachal Pradesh	47135	68	West Bengal	168449		19
6.	Kerala	45777	17	Maharashtra	166422		16
7.	Tamil Nadu	41410	59	Himachal Pradesh	165372		17
8.	Gujarat	39966	72	Kerala	162610		6
Lower income group							
9.	Andhra Pradesh	35900	70	Punjab	132700		18
10.	Rajasthan	32756	84	Andhra Pradesh	129697		24
11.	West Bengal	29775	63	Odisha	93716		36
12.	Assam	27968	76	Rajasthan	87288		32
13.	Odisha	27759	122	Assam	72996		36
14.	Madhya Pradesh	26328	111	Madhya Pradesh	69429		43
15.	Uttar Pradesh	21522	99	Uttar Pradesh	49973		38
16.	Bihar	11185	75	Bihar	33979		27

Source: Compiled by the author, EPWRF and RBI

Table 1: Per capita income and infant mortality rate of major states in India

The Table 1 highlights some interesting findings notably, there was a positive correlation between PCI and IMR, as higher income states tended to exhibit lower IMR, while lower income states reported higher IMR except Haryana and Gujarat. States in the higher income group, such as Haryana and Gujarat witnessed significant economic growth, evident from their substantial increase in per capita income. Remarkably, these states also experienced considerable improvements in infant mortality rates, it is high compared to other high income group. To address this discrepancy between high economic growth and elevated infant mortality rates, a comprehensive approach is needed. This includes targeted investments in healthcare infrastructure, improved access to quality healthcare services for all segments of the population, better maternal and child health education, enhanced nutrition and sanitation programs, and addressing socioeconomic disparities. Sustainable development requires not only economic progress but also equitable distribution of its benefits and improvements in healthcare and social services to ensure the well-being of all citizens, including infants.

Among the lower income group states, Bihar consistently reported the lowest per capita income, reflecting its relatively disadvantaged economic status. Despite this, Bihar displayed a remarkable reduction in IMR, from 75 in the initial year to 27 in the final year. This improvement indicates advancements in healthcare interventions and infrastructure, showcasing the potential impact of targeted healthcare initiatives in tackling infant mortality. However, Assam remained a concern, having the highest IMR in both years, underscoring the need for focused interventions to address infant mortality in the state.

Overall, the data suggests that states in the higher income group tended to have higher per capita income and lower IMR (except Haryana and Gujarat) compared to those in the lower income group, both in the initial and final years. This indicates a convergence of development across major Indian states, as those with higher initial per capita income demonstrated sustained economic growth and improved health outcomes. Along with this, it is essential to consider additional factors that may contribute to the variation in infant mortality rates across states. Socioeconomic factors such as female literacy rates, fertility rates, and women's participation in the labour force play pivotal roles in shaping infant health outcomes.

Table 2 presents a comprehensive overview of the Infant Mortality Rate (IMR) trends across various states of India during the years 1990, 2000, 2010, and 2020, along with corresponding ranks. This dataset provides valuable insights into the evolving dynamics of infant mortality rates within the Indian states and underscores the significant improvements witnessed over the given time span.

The data indicates significant improvements in infant mortality rates across various states in India from 1990 to 2020. Kerala consistently maintained the lowest IMR in both years, showing its strong healthcare system. By 2020, Kerala continued to maintain its position as the state with the lowest IMR, further

improving it to 6. This signifies the state's consistent efforts in providing effective healthcare services, ensuring prenatal care, and implementing successful interventions to reduce infant mortality.

States	IMR 1990	Rank	IMR 2000	Rank	IMR 2010	Rank	IMR-2020	Rank
Kerala	17	1	14	1	13	1	6	1
Maharashtra	58	2	48	2	28	3	16	3
Tamil Nadu	59	3	51	3	24	2	13	2
Punjab	61	4	52	4	34	5	18	5
West Bengal	63	5	51	3	31	4	19	6
Himachal Pradesh	68	6	51	3	40	7	17	4
Haryana	69	7	67	7	48	11	28	10
Karnataka	70	8	57	5	38	6	19	6
Andhra Pradesh	70	8	65	5	46	9	24	8
Gujarat	72	9	62	6	44	8	23	7
Bihar	75	10	62	6	48	10	27	9
Assam	76	11	75	8	58	13	36	12
Rajasthan	84	12	79	9	55	12	32	11
Uttar Pradesh	99	13	83	10	61	14	38	13
Madhya Pradesh	111	14	87	11	62	15	43	14
Orissa	122	15	95	12	61	14	36	12

Source: Compiled by the author; RBI and EPWRF.

Table 2. Infant Mortality Rate of Major States in India with Rank

The provided data allows us to observe some convergence in IMR among the states over time. States like Bihar show improvements in their ranks, suggesting convergence towards lower IMR levels. However, some states, such as Tamil Nadu and Gujarat, show fluctuations in ranks, indicating that convergence may not be uniform across all states. States in southern India, such as Kerala, Tamil Nadu, and Karnataka, consistently perform well with lower IMR and higher ranks. States in eastern and central India, such as Odisha, Bihar, and Madhya Pradesh, tend to have higher IMR and lower ranks.

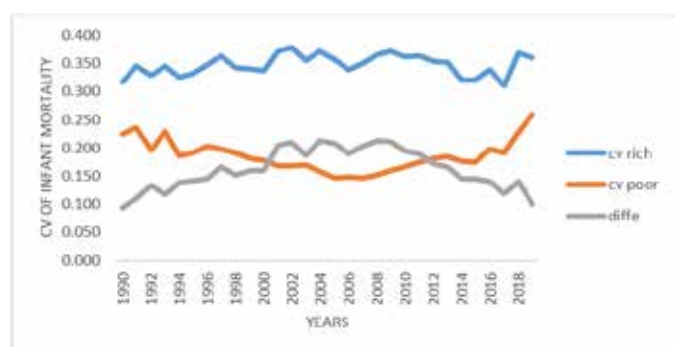
It is important to note that while the data provides insights into the trends and relative performance of states in terms of IMR, additional analysis and consideration of factors such as healthcare infrastructure, socio-economic conditions, and policy interventions are necessary to draw comprehensive conclusions about the convergence of development among the states of India. There is a general trend of decline in IMR across states over the years. This indicates improvements in healthcare, access to medical facilities, and overall development efforts aimed at reducing infant mortality.

Despite the overall decline, there are variations in the pace of progress and performance among states. Some states show more significant improvements in reducing IMR compared to others. This differential progress suggests that convergence of development in terms of infant mortality may not be uniform across all states. Some states demonstrate convergence in terms of IMR over time. States like Bihar and Madhya Pradesh show improvements in their ranks, indicating a convergence towards lower IMR levels. This suggests that initially disadvantaged states are catching up with better-performing states.

4.1 Convergence of Development: Sigma Convergence Approach

Here, the study employed sigma convergence to assess the

convergence or divergence of economic development across the major states in India. It focuses on whether the dispersion in health indicator like infant mortality is narrowing or converging over time. In the context of Indian states, the sigma convergence approach analyses whether there is a reduction in disparities in development among the states over a specific period. It involves calculating the standard deviation or coefficient of variation of the selected development indicator across the states at different points in time. If the standard deviation or coefficient of variation decreases over time, it indicates convergence, suggesting that the income gaps among the states are narrowing. The coefficient of variation (CV) is utilized as a measure to assess the dispersion of infant mortality rates across Indian states. The CV takes into account the standard deviation relative to the mean, thereby providing insights into the degree



of variation in infant mortality rates.

Source: Drawn by the author; RBI and EPWRF

Figure 1. Co-efficient of variation of infant mortality across the States

In a converging scenario, states with initially lower development tend to catch up to or grow faster than states with higher initial development, leading to a decrease in variability. The difference of CV of infant mortality of rich and poor states shows an inverted U shaped curve. An inverted U-shaped curve in the coefficient of variation suggests a distinctive pattern in the convergence of development. The empirical analysis reveals an intriguing pattern of convergence in the development across Indian states, as evidenced by the inverted U-shaped curve of the coefficient of variation of infant mortality rates. Initially, states with high levels of infant mortality exhibit substantial disparities, resulting in a high coefficient of variation. However, as time progresses, less developed states experience a decline in infant mortality rates, resulting in a convergence of development indicators. Consequently, the coefficient of variation follows a downward trajectory, reflecting the narrowing of disparities and indicating a trend toward convergence.

The observed inverted U-shaped curve of the coefficient of variation underscores the presence of both divergence and convergence phases in the developmental trajectory of Indian states. The initial divergence is attributed to varying levels of healthcare infrastructure, socio-economic disparities, and regional inequalities. Subsequently, policy interventions, healthcare advancements, and socio-economic improvements contribute to the observed convergence. The findings along with theories of development convergence, suggesting that

over time, less developed regions tend to catch up with more developed ones. The trajectory of convergence, as indicated by the inverted U-shaped curve, highlights the crucial role of targeted development policies and interventions in promoting equitable socio-economic progress across Indian states.

The study on the convergence of development among 16 major states of India, with infant mortality rate (IMR) as the indicator, has revealed significant findings that shed light on the progress and disparities in development across the regions. The analysis of the coefficient of variation of IMR over time indicates a decreasing trend, suggesting a tendency towards narrowing disparities in infant mortality rates among these states. This trend signifies a positive development as it reflects an improving scenario in terms of healthcare access, quality of life, and socioeconomic factors influencing infant mortality.

Furthermore, the study has unveiled a strong association between per capita income and IMR, where states with higher per capita income tend to exhibit lower infant mortality rates. This finding underscores the role of economic development in improving healthcare facilities and accessibility, which in turn positively impacts infant survival rates. States with higher income levels have been able to invest more in healthcare infrastructure, maternal and child health programs, and nutrition interventions, resulting in better health outcomes for infants.

While the convergence of IMR is evident, the study also highlights the presence of persisting disparities among the states. Some regions continue to face challenges related to healthcare access, sanitation, nutrition, and socioeconomic conditions, which contribute to higher IMR. These disparities necessitate targeted and tailored interventions to address the specific needs and challenges faced by these states.

Overall, the study underscores the importance of continued efforts in promoting convergence of development across major states of India, with a focus on further reducing infant mortality rates. Policymakers and stakeholders should recognize the significance of healthcare infrastructure, maternal and child health programs, sanitation facilities, and socioeconomic factors in achieving better health outcomes for infants. By addressing these factors comprehensively and targeting areas with persisting disparities, India can advance towards achieving sustainable and equitable development, ensuring a healthier and more prosperous future for its citizens. The convergence witnessed in development indicators, particularly infant mortality rates, signifies a commendable trend towards equitable access to basic healthcare and social services. This could be attributed to concerted efforts in healthcare policy, improved healthcare infrastructure, and awareness campaigns.

5. POLICY IMPLICATIONS AND SUGGESTIONS

The IMR serves as a key indicator reflecting the overall health and well-being of a society, impacted by various determinants, including economic development, healthcare access, nutrition, and sanitation. Studies have shown that socioeconomic factors alone explain only a limited portion of the observed disparities in IMR.

To effectively enhance economic development, policymakers should focus on enhancing healthcare infrastructure, strengthening primary healthcare services, and promoting maternal and child health programs. Nutrition interventions, access to clean water, and sanitation facilities are equally crucial in combating malnutrition and reducing infections that contribute to IMR. Furthermore, addressing socio-economic disparities through targeted support and awareness campaigns can improve healthcare-seeking behaviour and access to essential services.

Data-driven decision-making and collaboration between government agencies, non-governmental organizations, and international partners are essential for implementing evidence-based policies and measuring their impact over time. By adopting a comprehensive and coordinated approach, states can successfully converge development efforts, significantly reducing IMR and fostering a healthier and more prosperous future for all communities. Further investment in primary healthcare services, along with targeted interventions to promote nutrition and maternal care, can help to improve overall health outcomes. For states with significant socio economic disparities, interventions should prioritize improving healthcare access in remote areas and marginalized communities. Investing in education, particularly for girls and women, will help empower individuals and reduce poverty.

6. CONCLUSION

In summary, the data found convergence in terms of infant mortality rate among states in India over the years, with initially disadvantaged states making progress towards reducing IMR. However, regional disparities persist, indicating the need for targeted efforts and policies to ensure more equitable development outcomes across all states. Further analysis considering various socio-economic factors and policy interventions would provide a more comprehensive understanding of the convergence of development among the major states in India. This study contributes to a deeper understanding of the complexities surrounding development convergence and underscores the significance of evidence-based policies in fostering equitable progress. The convergence in this domain suggests that states are collectively moving towards a more balanced provision of essential services, ensuring that even historically disadvantaged regions are making substantial strides.

ACKNOWLEDGEMENT

"I would like to express my sincere gratitude to the Indian Council of Social Science Research (ICSSR), Delhi for their generous funding support that made both the research project and the subsequent publication of this work possible. Their financial assistance not only facilitated the exploration of critical issues but also allowed for the dissemination of valuable knowledge.

REFERENCES

1. Ahluwalia, M. S. (2002). State level performance under economic reforms in India. *Economic policy reforms and the Indian*

- economy, 91-125.
2. Apergis, N., & Padhi, P. (2013). Health expenses and economic growth: convergence dynamics across the Indian States. *International journal of health care finance and economics*, 13(3-4)
3. Andrew J. Barenberg, Deepankar Basu & Ceren Soylu (2017) The Effect of Public Health Expenditure on Infant Mortality: Evidence from a Panel of Indian States, 1983–1984 to 2011–2012, *The Journal of Development Studies*, 53:10, 1765-1784, DOI: 10.1080/00220388.2016.1241384
4. Barenberg, A. J., Basu, D., & Soylu, C. (2017). The effect of public health expenditure on infant mortality: evidence from a panel of Indian states, 1983–1984 to 2011–2012. *The Journal of Development Studies*, 53(10), 1765-1784.
5. Barman, N., & Talukdar, D. (2014). Socio-Demographic factors affecting infant mortality rate in Assam. *International Journal of Science, Environment and Technology*, 3(5), 1893-1900
6. Chadha, N., & Nandwani, B. (2019). Growth, Development Spending, and Inequality in Indian States. *Economic & Political Weekly*, 54(11), 45.
7. Cherodian, R., & Thirlwall, A. P. (2015). Regional disparities in per capita income in India: convergence or divergence? *Journal of Post Keynesian Economics*, 37(3), 384-407.
8. Drèze, J., & Sen, A. (Eds.). (1997). *Indian development: Selected regional perspectives*. Oxford University Press.
9. Ghosh, B., Marjit, S., & Neogi, C. (1998). Economic growth and regional divergence in India, 1960 to 1995. *Economic and Political Weekly*, 1623-1630.
10. Goli, S., & Arokiasamy, P. (2014). Trends in health and health inequalities among major states of India: assessing progress through convergence models. *Health Economics, Policy and Law*, 9(2), 143-168
11. Gunji, H., & Nikaido, Y. (2010). Convergence across Indian states: a re-evaluation. *Journal of International Economic Studies*, (24), 133-153.
12. Madhusudan Ghosh. (2006). Economic Growth and Human Development in Indian States. *Economic and Political Weekly*, 41(30), 3321–3329.
13. Majumdar, G., & Kapoor, J. L. (1980). Behaviour of inter-state income inequalities in India. *Journal of Income and Wealth*, 4(1), 1-8.
14. Nagaraj, R., Varoudakis, A., & Véganzonès, M. A. (2000). Long run growth trends and convergence across Indian States. *Journal of International Development: The Journal of the Development Studies Association*, 12(1), 45-70.
15. Nair, K. R. G. (1971). A note on inter state income differentials in India 1950–51 to 1960–61.
16. Narayan, L. (2017). Convergence or divergence: An analysis of regional disparities in South Asian countries. *Convergence*, 4(7).
17. Philip, E. (1985). Why infant mortality is low in Kerala. *Indian journal of pediatrics*, 52(418), 439-443.
18. Rao, M. G., Shand, R. T., & Kalirajan, K. P. (1999). Convergence of incomes across Indian states: A divergent view. *Economic and Political Weekly*, 769-778.
19. Ray D. *Development economics*. New Jersey: Princeton University Press; 2015.
20. Sanga, P., & Shaban, A. (2017). Regional divergence and inequalities in India. *Economic & Political Weekly*, 52(1), 102-10.
21. Sanyal, A., & Singh, N. (2022). Structural change and economic growth in India: a comparative study of Punjab. *Indian Growth and Development Review*, 15(1), 1-17.
22. Sen, A. (1988). The concept of development. *Handbook of development economics*, 1, 9-26.
23. Suriyakala, V., Deepika, M.G., Amalendu, J., Deepa, G. (2016).

Factors Affecting Infant Mortality Rate in India: An Analysis of Indian States.

24. Thirlwall, A. P. (2013). Regional Disparities in Per Capita Income in India: Convergence or Divergence? (No. 1313). School of Economics, University of Kent.
25. Trivedi, K. (2003). Regional convergence and catch-up in India between 1960 and 1992. UK: Nuffield College.